Papaya Mosaic Virus Transmission as Affected by the Duration of the Preliminary Fasting and Virus Acquisition Feeding of *Myzus Persicae*[1]

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The relationship in which plant pathogenic viruses remain infective with the aphid vector for a short period of time, generally less than an hour after being acquired by the aphid, has been classified as non-persistent (Watson and Roberts 1939). With this type of relationship the transmission of the virus is enhanced when aphid vectors are kept away from food (preliminary fasting) for a period of time prior to a virus acquisition probe of short duration (Watson 1938; Sylvester 1947, 1954). However, it is possible to attain the same level of transmission without preliminary fasting if the aphids are handled with special care during the transmission tests (Bradley 1961). Under usual test circumstances, preliminary fasting is beneficial. The effective range of the preliminary fasting period varies with the virus-vector combination and is generally from several minutes to a few hours (Sylvester 1954). Also, with the non-persistent relationship the duration of the acquisition probe should be short, and the effective range appears to be from several seconds to a few minutes (Sylvester 1954). Within the effective ranges, the effect of the various durations of the acquisition probes and preliminary fasting periods has not been investigated intensively for most vector-virus combinations.

In our search for plant varietal resistance to the aphid transmission of the papaya mosaic virus, we conducted tests wherein the data for duration of the acquisition probe, preliminary fasting period, and transmission occurrence were recorded for 4000 aphids. The data presented here are compiled to show the effect of the duration of the preliminary fasting period on transmission, the frequency distribution and the transmission rates of acquisition probes of various durations, transmission rates of tests conducted in the morning and afternoon, and the frequency distribution of 30-sec probes with relationship to the duration of the preliminary fasting period.

MATERIALS AND METHODS

The vectors were mature apterae of the green peach aphid, *Myzus persicae* (Sulzer). They were the progeny of a single female. Colonies of

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aphids from this female have been maintained in our greenhouse for many years on mustard cabbage, *Brassica juncea* (L.) Cosson. Only aphids that were in feeding position on the colony plant were aspirated and used in the tests. They were then kept in empty glass vials for at least 30 min before allowing them access to the virus source. Each aphid during the virus acquisition probe was watched with a hand lens and timed with a metronome set at 120 beats per min. The aphids were allowed to make only one probe of 10- to 30-sec duration. Aphids making initial probes of less than 10 sec were discarded. Aphids still in probing position at 30 sec were picked off at that time with a camel's hair brush. After the acquisition probes, the aphids were immediately placed on the test plants, one aphid per plant.

The virus sources were leaves of young papaya plants infected with the papaya mosaic virus. The test plants were either papaya, *Carica papaya* L., in the 4-6 leaf stage or cucumber, *Cucumis sativus* L., in the cotyledon stage. All plants were grown in sterilized soil in 3-in plastic pots. After being on the test plants for at least ½ hour the aphids were killed by means of nicotine-sulphate spray. Test plants were placed in an insect-proof greenhouse until manifestation of disease symptoms.

This study consisted of 20 trials of 200 aphids per trial. One trial was conducted per day, half of it during the morning and the other half during the afternoon. The aphids were fasted and the tests were conducted in an air-conditioned room with a temperature of 23° to 24°C.

Results and Discussion

Under conditions of the experiment, transmission rates of the tests conducted in the morning were sometimes higher than those conducted in the afternoon and sometimes vice versa. There was a total of 797 transmissions out of 2000 attempts in the morning and 777 out of 2000 in the afternoon. The chi-square test indicated that the evidence for the difference was not significant.

TABLE 1.—*Effect of duration of preliminary fasting period of green peach aphid on transmission of papaya mosaic virus.*

Fasting period (min)	Percent Transmission
31-40	45.4
41-50	38.5
51-60	40.9
61-70	41.6
71-80	38.6
81-90	40.8
91-100	39.2
101-110	36.4
111-120	33.7
121-130	28.7

Table 1 shows the effect of the duration of the preliminary fasting of the green peach aphid on the transmission of the papaya mosaic virus. Preliminary fasting periods were grouped into 10-min increments ranging from 31-40 to 121-130 min. Transmission was highest (45.4%) with aphids that were fasted for 31-40 min and lowest (28.7%) for those that were fasted from 121-130 min. From 41-100 min of fasting the transmission rates were about the same; thereafter, there was a slight gradual decrease.

Table 2 presents frequency distribution and the transmission rates of the virus acquisition probes of various duration. The majority of the probes were 30 sec in duration. Actually most of these 30-sec probes would have been longer since the aphids were still in probing position at 30 sec when they were forcefully picked off the virus-source leaf with a camel's hair brush. The 10-sec probes were the fewest in number and the transmission rate of these probes were the lowest. This low transmission rate can perhaps be attributed to the approximation of 10 sec to what is most likely the virus acquisition threshold period for most non-persistent vector-virus relationships. The shortest acquisition threshold periods recorded for non-persistent viruses approximate 10 sec (Sylvester 1954). Furthermore, in our tests many of the aphids may have had their proboscises in firm contact with the leaf surface for 10 sec, but we had no way of knowing whether their stylets had penetrated into the epi-

TABLE 2.—*Frequency distribution and transmission rates of virus acquisition probes of various durations in transmission of papaya mosaic virus by green peach aphid.*

Duration of probes (sec)	Percent transmission	Percent of total probes*
10	25.9	0.67
11	38.5	0.97
12	42.9	1.92
13	42.9	2.10
14	55.3	2.35
15	50.0	3.00
16	37.6	2.52
17	41.0	2.07
18	46.2	2.65
19	48.6	1.85
20	39.1	2.87
21	54.1	1.52
22	42.3	1.30
23	44.0	1.25
24	40.0	1.50
25	45.7	2.12
26	47.3	1.37
27	51.7	1.45
28	43.8	1.20
29	50.0	0.75
30	36.5	64.50

* n = 4000

dermis for the full 10 sec. Hence the stylets may have been in penetration for less than 10 sec and may have not had adequate time to pick up the virus.

The transmission rate for the 30-sec probes was relatively lower than those of the other durations except for those of 10 sec. The rate may have been effected by the unnatural termination of most of the 30-sec probes. Bradley (1952) and Sylvester (1954) give evidence that transmission rates for aphids that had their acquisition probes forcefully terminated were lower than those that naturally terminated their probes.

Out of the total number of probes, 2579 (64.5%) were of 30-sec duration. Table 3 gives distribution of these 30-sec probes in relationship to the duration of the preliminary fasting period, expressed as percentages of the probes of each preliminary fasting period increment. The data indicated that, under the conditions of this study, proportionately more aphids are likely to make an initial probe of 30 sec or longer after a longer preliminary fasting period than after a shorter one. There was a gradual increase of 30-sec probes from 53.1% for the 31 to 40-min increment to 78.1% for the 121 to 130-min increment. When we relate this to the data of Tables 1 and 3 it becomes evident that the gradual decrease in the transmission rate with the increase in the duration of the preliminary fasting period could be a reflection of the gradual increase in the number of 30-sec probes instead of the effect of the length of the preliminary fasting period *per se*. Or, that both the number of 30-sec probes and the length of the preliminary fasting period contributed in decreasing the transmission rate.

TABLE 3.—*Frequency distribution of 30-sec virus acquisition probes by green peach aphid in relation to duration of preliminary fasting periods.*

Fasting period (min)	Percent of probes in increment
31-40	53.1
41-50	60.8
51-60	60.9
61-70	65.5
71-80	64.2
81-90	67.5
91-100	66.5
101-110	68.9
111-120	73.1
121-130	78.1

In view of our data, if it is necessary in the transmission tests to reduce the number of 30-sec or longer probes, we suggest that the aphids not be fasted more than 1.5 hours. This could be accomplished, in test circumstances such as in this study, by aspirating aphids for fasting at different times during the course of the test. Another suggestion is to use aphids from uncrowded colonies. We have observed that aphids in such a situa-

tion were generally more active and initiated probes on the virus source faster and were more apt to make probes of shorter duration than those from crowded ones.

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